THE UNIVERSITY OF ALBERTA

A COMPARISON OF THE 12-MINUTE AND 800-METER RUN-WALKS AS MEASURES OF AEROBIC CAPACITY OF YOUNG WOMEN

by

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The undersigned certify that they have read and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled "A Comparison of the 12-Minute and 800-Meter Run-Walks as Measures of the Aerobic Capacity of Young Women" submitted by Dianne E. Van Hesteren in partial fulfillment of the requirements for the degree of Master of Arts.

ABSTRACT

The purpose of this study was to determine which of the two field tests, the 800-meter run-walk and the 12-minute run-walk, was the best predictor of cardio-respiratory fitness in women, using a modified Mitchell, Sproule and Chapman Maximal Oxygen Intake Test as the criterion measure.

Thirty-three female volunteer subjects enrolled as students at the University of Alberta participated in the required physical education program.

The 12-minute run-walk and the 800-meter run-walk tests were administered alternately to each subject, two times in the twenty-day testing period. In the two weeks following the practical testing, each subject performed a modified Mitchell, Sproule and Chapman test in the laboratory.

It was concluded that there was no significant difference at the .05 level between the correlation coefficients obtained by correlating the Mitchell, Sproule and Chapman test with the 12-minute run-walk and the 800-meter run-walk. Although the 12-minute run-walk and the 800-meter run-walk tests yielded reliability coefficients of .78 and .88 respectively, neither of the tests appear to be good predictors of cardio-respiratory fitness for young college women.

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CHAPTER I

STATEMENT OF THE PROBLEM

Introduction

The amount of oxygen an individual can take in, transport, and utilize during heavy prolonged work is considered by many exercise physiologists to be the best measure of physical fitness (1,11,19,20,26). This ability to use oxygen is called aerobic capacity, and does indicate the subject's cardio-respiratory fitness (10). The aerobic capacity of an individual refers to the maximum volume of oxygen that he or she is capable of providing to meet the energy requirements of prolonged exercise.

The most accurate assessment of physical fitness is by direct measurement of the maximal oxygen intake (MVO_2) (21). Cooper (11:203) states:

> Maximal oxygen consumption as determined in the laboratory continues to be the best indicator of cardiovascular fitness. However, the expense, time, and personnel requirements will continue to make this procedure prohibitive for testing large groups.

An indirect estimate of oxygen consumption which could be used to accurately predict MVO_2 would allow large numbers of people to test themselves as to their level of physical fitness. These indirect measures of MVO_2 include submaximal tests which are conducted in the laboratory, or those which are administered to large groups as a practical or field test.

In this study the field tests which will be compared with regard

to their predictive value of physical fitness for young college women are the 12-minute run-walk and the 800-meter run-walk. A review of the literature indicates that women respond differently than men to sub-maximal or maximal tests of MVO_2 (3,24,30,31). Although the 12-minute run-walk and the 1,000-meter run-walk tests have been compared with one another and with a direct measure of MVO_2 for male subjects (29), the study of the 12-minute run-walk and the 800-meter run-walk has not yet been completed using female subjects.

The Problem

The purpose of this study is to compare the 12-minute and the 800-meter run-walk tests as predictors of cardio-respiratory fitness. Aerobic capacity as predicted by these field tests is correlated with a direct measure as determined by the Mitchell, Sproule and Chapman Maximal Oxygen Intake Test. The tests to be used include the 12-minute run-walk test for distance, the 800-meter run-walk test for time, and the Mitchell, Sproule and Chapman Maximal Oxygen Intake Test for maximal oxygen intake.

The 12-minute and the 800-meter tests will be correlated with the Mitchell, Sproule and Chapman Test, resulting in an estimate of the validity of these two measures.

Main Hypotheses

The null hypothesis (H_o) asserts that no differences exist at the .05 level of significance between the correlations of the 12-minute run-walk and the Mitchell, Sproule and Chapman Test (r_a) and of the 800-meter run-walk and the Mitchell, Sproule and Chapman Test (r_b).

$$H_o : r_a = r_b$$

The alternate hypothesis (H_1) asserts that differences do exist at the .05 level of significance between the correlations obtained from

the two tests with the Mitchell, Sproule and Chapman Test.

$$H_1 : r_a \neq r_b$$

Subsidiary Problem

A secondary problem will be to determine the reliability of both the 12-minute run-walk and the 800-meter run-walk.

Justification for the Study

There is a need today for a number of simple and inexpensive field tests which will give interested women an accurate and reliable estimation of their aerobic capacity or physical fitness. This study will attempt to determine the usefulness of the 12-minute and the 800-meter run-walks as predictors of the aerobic power of young women.

Delimitations of the Study

The study was confined to thirty-three female volunteers who were enrolled in the first year required physical education program at the University of Alberta.

Limitations of the Study

Variations in temperature and humidity were not controlled in the laboratory and arena.

It was not determined how closely the subjects followed the instructions regarding eating, smoking and exercise prior to the laboratory test.

Definition of Terms

Aerobic Capacity. The ability of the individual to transport and utilize sufficient oxygen to meet the demands of the activity.

Anaerobic Work. That work which depends on lactic acid metabolism as the energy source.

Endurance Fitness. The ability to do prolonged work aerobically.

Field Test. A test which can be administered to a large number of people at one time and does not require the use of expensive laboratory equipment or trained personnel.

Maximal Oxygen Intake = Maximum Oxygen Consumption = Maximum Oxygen Uptake = MVO_2. A measure "of the maximal capacity of the cardiovascular-respiratory system to take up, transport and give off oxygen to the working tissues and for these tissues to use oxygen" (20:4).

Maximal Test. A test which requires the subject to reach maximal oxygen uptake before the testing is terminated.

Submaximal Test. A test in which the subject is not required to reach maximal oxygen uptake.

CHAPTER II

REVIEW OF THE LITERATURE

The Mitchell, Sproule and Chapman Maximal Oxygen Intake Test (34), the 12-minute run-walk (10) and the 800-meter run-walk (27) tests administered in this study will be examined through a review of the relevant literature. Studies reporting significant sex differences in the performance of these tests will also be discussed.

The Mitchell, Sproule and Chapman Maximal Oxygen Intake Test.

The use of maximal oxygen uptake as a measure of fitness is supported by a number of exercise physiologists (1,11,19,20,26). For example, in a recent article by Drake et al. (19:844), it was stated:

> There is now widespread agreement among physicians and physiologists that the basic measure of cardiorespiratory health is an individual's maximum oxygen intake.

Falls et al. (20:192) refer to MVO_2 measures as the "ultimate criterion of physical fitness". Astrand's and Ryhming's (4) claim that aerobic capacity expressed in kilograms of body weight per minute is a good measure of physical fitness is supported by Buskirk and Taylor (9).

Tests that have been devised to measure MVO_2 make use of the bicycle ergometer or the motor-driven treadmill. The disadvantage of the bicycle ergometer tests is that they require unusual leg strength in a culture unaccustomed to cycling (21). Glassford et al. (22) found that the two treadmill tests, the Mitchell, Sproule and Chapman Maximal Oxygen Intake Test and the Taylor, Buskirk and Henschel Treadmill Test, and the indirect measure of MVO_2, the modified Astrand-

Ryhming Nomogram, yielded significantly higher mean values of MVO_2 than did the modified Astrand Bicycle Ergometer Test of Maximal Oxygen Uptake. Newton (37) and Astrand (5) confirmed this finding when, individually, they reported significantly higher mean MVO_2 values on the treadmill test than on the bicycle ergometer test.

The Mitchell, Sproule and Chapman test (34) is a treadmill test of MVO_2 which has been used in a number of recent studies as a criterion measure of physical fitness (10,29,44). This test increases the work load by raising the percent grade of the treadmill with the speed remaining constant, as was recommended by Taylor et al. (43). Taylor (43) also indicated that a five-minute warm-up period was inadequate and, therefore, Mitchell et al. (34) incorporated a 10-minute warm-up period on the treadmill at three miles per hour at a 10 percent grade. The reliability of this test is reported by Taylor (44) to be .83 for females and .88 for the males.

Comparison of MVO_2 Values for Males and Females.

Due to physiological characteristics of the female, their MVO_2 values tend to be significantly lower than those of the male subjects (44).

Astrand (2) found that the decrease in MVO_2 per kilogram of body weight in the female started at the age of 12 years and that this difference between males and females with regard to MVO_2 was simply a consequence of sexual maturity. In a later article, Astrand (3) reported that the MVO_2 and the blood hemoglobin measures for the females were less than the males by 29 percent and 30 percent respectively. He concluded that the lower aerobic capacity of women was due to a lower fat-free body mass and to a smaller muscular mass.

Astrand (2) suggests that MVO_2 measures are influenced by psychological factors, peripheral circulation, and central circulation or physical work capacity of the heart, in that order. He defines psychological factors as the different reactions of individuals to feelings of discomfort and fatigue.

When studying the differences in the maximal and submaximal work capacity of 24 men and 24 women, Mcnab et al. (30) administered the following tests: the Mitchell, Sproule and Chapman and the Astrand Bicycle Ergometer tests of MVO_2, the Sjostrand PWC_{170} and the Progressive Step PWC_{170} submaximal tests, and an estimation of body density. In all of these tests, the men exhibited significantly higher scores (P=0.01) than women even when the differences were expressed per unit of fat-free body weight.

McGill et al. (31) contradict the findings of Macnab et al. (29) by stating that there are no significant differences between MVO_2 values of men and women when related to fat-free body weight.

It has been postulated that the hemoglobin content of the blood, the cardiac output, the pulmonary ventilation and the lung capacity seem to account for the differences found between males and females in physical work capacity (2).

Although Astrand, P-O (2), found that, for the untrained Swedish females, there was a high correlation between MVO_2 in liters per minute and body weight under 40 kilograms (r=.96) and over 40 kilograms (r=.86), Michael and Horvath (33) report a low correlation when comparing MVO_2 in milliters per kilogram to body weight (r=.32) for their untrained American female sample. The ventilation appeared to be the measurement which differentiated the Swedish and American subjects (33).

Olree et al. (38) report that the single independent variable contributing most to the prediction of oxygen consumption per kilogram for females 12-18 years was the estimate of MVO_2 in milliliters per kilogram from the Astrand Submaximal Bicycle Test. For the male sample 12-18 years, the 600-yard run was the best predictor of MVO_2 in milliliters per kilogram of body weight.

The Run-Walk Field Tests.

There are certain factors which must be considered in the development and use of a good field test. Balke (6:1) writes:

> A field test of physical competence should engage a familiar type of physical exercise, involving large muscle groups and eliciting general functional responses within and up to the limits of capacity. The test accomplishments should be measurable in commonly understandable terms and readily convertible into data of physiological significance.

He states further (6:1) that "The type of exercise which comes very close to fulfilling most of these requirements is the work of walking and running".

Although Drake et al. (19:848) concludes that, on the basis of their research, performance tests should not be used to predict aerobic power. They add, "It is possible that performance tests could be used to predict MVO_2 if a longer run (one or two miles) were included in the test battery".

Many authors believe that the motivation of the subjects is a major factor influencing the results obtained in field testing (2,11,19, 27,33). However, Cooper (11:203) reports:

> ...in young, well-motivated subjects, field testing can provide a good assessment of maximal oxygen consumption, but the accuracy of the estimate is related directly to the motivation of the subjects.

The 12-Minute Run-Walk Test.

Balke (6) compared the MVO_2 values obtained for eight male subjects from the treadmill test with the oxygen requirements calculated for runs of 1, 5, 12, 20 and 30 minutes duration. The treadmill results correlated most highly with the results obtained in the runs of approximately 10-20 minutes duration. He concluded (6:7) therefore that:

> Since only the assessment of the aerobic work capacity is useful as a realistic measure of the potentially available functional reserves, the duration of a physiologically meaningful field test should be at least 12 minutes.

In a study conducted by Cooper (11), 115 U. S. Air Force male officers and airmen were evaluated on the 12-minute run-walk test and on a treadmill MVO_2 test. The correlation of the 12-minute run-walk data with the laboratory-determined MVO_2 data was 0.897. Similar results (r=0.90) were reported by Doolittle and Bigbee (18) on the same tests administered to nine adolescent boys. In Lavoie's (29) study, 23 college men were tested on the treadmill with the Mitchell, Sproule and Chapman Maximal Oxygen Intake Test, and on the 12-minute field test. The correlation of the two tests was .68 and the reliability of the 12-minute test-retest reported by Lavoie (29) was 0.95.

Referring specifically to the 12-minute run-walk test, Cooper (11:203) lists the advantages of this test:

> ...it uses a well-known type of exercise, i.e. walking and running; it costs nothing to perform; large groups can be run together; and trained personnel are not required.

The 800-Meter Run-Walk Test.

The International Committee for the Standardization of Physical Fitness Tests (I.C.S.P.F.T.) uses an endurance run as one of its test

items (27). Men and boys 11 years and over run 1,000 meters; women and girls 11 years and over run 800 meters; and children under 11 years run 600 meters. Ullmark (27), Simri (27) and Balke (27) commented that the endurance run must be over a greater distance or of a longer duration in order to be a measure of cardiovascular endurance. Balke (27) fixed the optimal distance for children under 12 years at 2,000 meters; for girls above 12 years, and for boys from 12 to 14 at 2,400 meters; and for males above 14 years of age at 3,000 meters.

There has been research comparing male subjects on the 12-minute and 600 yard run-walks. The correlation on the two tests was reported by Cooper (11) to be .83. Rank MVO_2 measures, when compared to rank 600 yard measures, exhibited a correlation of .62 in a study done by Doolittle and Bigbee (18). Falls et al. (20) found that the best single estimator of MVO_2 in the AAHPER test items was the 600 yard run-walk.

CHAPTER III

METHODS AND PROCEDURES

Sample

Thirty-three female volunteer students were subjects in this study. They were all attending the University of Alberta and were enrolled in the required physical education service program.

Order of Testing

The 12-minute run-walk and the 800-meter run-walk tests were completed by all subjects over a period of twenty days. In order to test a large group at one time, the sample was randomly divided into two groups. On a test day, group one would perform the 12-minute run-walk while group two recorded the distances covered. Following the 12-minute run-walk, group two would run the 800-meter run-walk while their partners in group one recorded their times. Each subject performed two trials of each test. There was a minimum of two days and a maximum of five days between the tests.

The Mitchell, Sproule and Chapman Test (34) was completed by all of the subjects in a fifteen day period following the field testing. The subjects were brought to the laboratory on the last day of the practical testing in order to select a time that was most convenient for their return to the laboratory to complete the Mitchell, Sproule and Chapman Test. The test was carefully explained to the subjects and finally they were instructed to refrain from eating for one and one-half hours before the test due to the effect of the ingestion of food on

performance (43). Cooper (13) reports that cardiopulmonary functioning is affected by cigarette smoking, resulting in bronchoconstriction. Therefore, in this study, the subjects were asked not to smoke thirty minutes prior to the test. They were also told not to engage in strenuous exercise for at least two hours before the test because oxygen consumption is elevated above normal during recovery from exercise (40,41).

Gas Collection and Analysis

A Collins triple J valve was used in order to enable the subject to inspire air from the outside and to expire air into the Douglas bags. A rubber mouthpiece was attached to the valve apparatus which was held in place by an adjustable headgear. The valve apparatus was connected by a rubber tube to the Douglas Bag into which the flow of expired air was controlled by means of a two-way valve. A rubber nose clip was used to clamp the nose. The air expired was analyzed for oxygen content with the Beckman E-2 oxygen analyzer and for the carbon dioxide content with a Godart Capnograph. The Parkinson Cowan volume meter was used to measure the volume of expired air.

Calibration of Instruments.

The Beckman E-2 oxygen analyzer and the Godart Capnograph carbon dioxide analyzer were calibrated immediately prior to testing by use of known samples of nitrogen and carbon dioxide gas.

12-Minute Run-Walk.

The 12-minute run-walk test was performed on the indoor concrete track which encircles the ice arena at the University of Alberta. Eight laps of the track is equal to one mile and the track itself was divided into eighths. Subjects were started at the same time and a stop watch was used to time the 12 minutes. A whistle was blown at the end of 12 minutes

to signal all subjects to stop running.

The subjects were told to pace themselves and to try to cover as much distance as possible in 12 minutes by running and, if necessary, by walking. They were informed of the time each time they passed the timer. The subjects' times were reported to the investigator by their partners and were recorded in laps to the nearest eighth. The following formula was used to convert the laps into meters:

$$\text{Meters} = \frac{\text{laps} \times 220.52 \text{ yards}}{1.0936}$$

In order to estimate the reliability of the 12-minute run-walk, a retest was administered to each subject on another test day by the same investigator and under similar conditions.

<u>800-Meter Run-Walk</u>.

The same track was used as in the 12-minute run-walk. An 800-meter run is four laps of the track minus 7.20 yards and therefore the finishing point was 7.20 yards behind the starting line. Subjects were reminded to pace themselves in order to cover the distance in the shortest possible time. They were told that walking was allowed if they could not continue running. Finishing times were called out by the timer as each subject crossed the finishing line, and their partners reported these times to the investigator for recording.

During the twenty day test period, each subject performed the 800-meter run-walk test twice, under the same conditions, in order to estimate the reliability of the measures.

<u>The Mitchell, Sproule and Chapman Maximal Oxygen Intake Test</u>.

When the subject came to the laboratory to perform this test, her height, age, and weight were recorded first, and then the mouthpiece and headgear were adjusted to fit comfortably. A short period of time

was allotted to familiarize the subject with the treadmill speeds which would be used. Then, the Mitchell, Sproule and Chapman Test (34) was administered in a modified form as follows:

1. A 10 minute warm-up period on the treadmill was performed by each subject at a speed of three miles per hour and at a 10 percent grade, followed by a 10 minute rest period in which the subject sat on a chair.

2. The subject was asked to stand on the treadmill in a ready position with the mouthpiece out of the mouth. The first exercise bout was run at six miles per hour and at a two and one-half percent grade for a period of 2.5 minutes.

3. After one minute, the subject was instructed to insert the mouthpiece that was attached to the Collins triple J Valve. A rubber nose clip pinched the nose closed so that no air could escape. Expired air was collected in the Douglas bag for the last 60 seconds of the 2.5 minute run.

4. A 10 minute rest period followed the exercise bout.

5. Analysis of the expired air was completed immediately.

6. The grade was increased by two and one-half percent with the speed held constant at six miles per hour for each exercise bout until the oxygen intake measured declined or levelled off. If the oxygen uptake increased by less than 0.054 liters per minute between two consecutive test runs, it was assumed that the maximal oxygen intake had been reached (34).

7. If the subject could not complete the 2.5 minute run, partial gas samples were collected and analyzed.

Statistical Procedures

The Mitchell, Sproule and Chapman Maximal Oxygen Intake Test (34) is considered to be an accurate direct measure of aerobic capacity by exercise physiologists, and was therefore used as the criterion measure. Reliability has previously been reported as .83 using a similar group of young women (44).

The reliability of the 12-minute and the 800-meter run-walk tests was determined by the use of the test-retest method.

Validity and reliability of the tests was calculated by use of the Pearson product-moment correlation.

The .05 level of significance was used in testing for differences between the two correlation coefficients.

CHAPTER IV

RESULTS AND DISCUSSION

Characteristics of Test Subjects

The sample consisted of 33 female volunteer subjects who were enrolled in the required service program in physical education at the University of Alberta. Table I gives the mean, standard deviation, and range of the age, height, and weight of the subjects.

Table I

AGE, HEIGHT, AND WEIGHT OF SUBJECTS

	Mean	Standard Deviation	Range
Age (Years)	19.88	3.63	18-35
Height (Inches)	64.58	2.60	60-70
Weight (Kg.)	58.21	8.76	43.18-76.82

Reliability of the Tests

The test-retest method was used to obtain two sets of scores for the 800-meter run-walk and the 12-minute run-walk. Reliability coefficients presented in Table II were calculated by use of the Pearson product moment correlation.

Table II

TEST RELIABILITY

Test	r
800-Meter Run-Walk	.88
12-Minute Run-Walk	.78

The reliability coefficients for the 1,000-meter and the 12-minute run-walks for men as reported by Lavoie (29) were .94 and .95 respectively. Although the 800-meter and the 12-minute test-retests were administered under the same conditions by one investigator, the reliability coefficients are lower for the female sample in this study. Other studies have also found that, in other work capacity tests, the reliability scores for the women are lower than those calculated for the male sample (33).

The 12-minute run-walk may be too heavy a work load to administer in a submaximal test of the cardiorespiratory fitness of women. Balke (6) warned that if the test is too long, factors such as fatigue and slipping motivation affect the test results. This may explain, in part, the reason why in this study, the reliability coefficient for the 12-minute run-walk test is lower than those for the shorter test, the 800-meter run-walk. Tolerance to feelings of discomfort and fatigue depend on the psychological orientation of the individual, and females may not be as motivated to withstand these feelings as are male subjects. This is supported by the findings of Olree (38) which report that the prediction of MVO_2 for girls (12-18 years) is best performed on a

submaximal bicycle test where there is little discomfort or fatigue. Males, on the other hand, can best determine MVO_2 indirectly by performing a test which depends more heavily on the motivation and tolerance of the subject, namely, the 600 yard run.

Results of Tests.

Table III presents the mean scores of all test results. The direct measure of MVO_2 in liters per minute was $1.68 \pm .45$ and in ml/kg/min was $28.80 \pm .633$. Table IV gives the MVO_2 values for women obtained in other studies.

As can be seen in Table IV the MVO_2 values for the college women of North America are lower than those reported for any Norwegian or Swedish female sample. A comparison of the modes of activity of the North American college women and the Norwegian and Swe dish women may yield some insight into this difference in cardiorespiratory fitness.

Correlation Analysis of the Mitchell, Sproule and Chapman Maximal Oxygen Intake Test With the 12-Minute Run-Walk and the 800-Meter Run-Walk.

The purpose of this study was to determine which one of the practical tests was the best predictor of cardio-respiratory fitness in women. Comparison of the correlation coefficients obtained when the two field tests were correlated with the Mitchell, Sproule and Chapman Test should give some indication as to which is more useful.

A computer zero-order correlation matrix based on the Pearson product-moment method was used to calculate the correlation coefficients shown in Table V.

The negative correlation coefficients included in Table V occur when the 800-meter times are correlated with MVO_2, in both L/min and ml/kg/min. These indicate the degree to which the subjects with the

fastest times in the 800-meter run-walk also had the greater MVO_2 values. Theoretically, if the 800-meter run-walk times were perfect predictors of cardio-respiratory fitness ($r = -1.00$), it could be stated that the subject who required the least time to complete the 800-meter run-walk would also have the highest MVO_2 value. The 12-minute run-walk correlates positively with MVO_2 in both L/min and ml/kg/min to indicate the degree to which the subjects who ran the farther distances also had the higher MVO_2 values.

The correlation coefficients obtained when the 800-meter T_1 and the 12-minute T_1 run-walks are compared with MVO_2 ml/kg/min are .40 and .45 respectively. This suggests that neither of the field tests are good predictors of cardio-respiratory fitness for women subjects. It appears that Cooper (12) is in agreement with the results of this study when he reports that the 12-minute run-walk correlated with MVO_2 ml/kg/min at .56 for a female sample of 103 women in the Air Force. He is currently investigating whether or not a time of 11:30 minutes or less for 1.25 miles is indicative of good physical fitness for women under 30.

In this study MVO_2 L/min correlated with body weight while there was a negligible correlation of body weight and MVO_2 ml/kg/min, as is shown in Table VI. This is in agreement with the findings of other studies such as Astrand (2) and Michael and Horvath (33). On the average, women have 20 to 30 percent body fat (43), and therefore the MVO_2 values are lower when reported in ml/kg/min.

Table III

MEAN SCORES OF TESTS

	Mean	Standard Deviation	Range
Mitchell, Sproule and Chapman (L/min)	1.68	0.45	.98-02.55
Mitchell, Sproule and Chapman (ml/Kg/min)	28.80	6.33	16.53-43.38
800-Meter Run-Walk (sec.) Trial 1	241.12	25.95	201.00-308
800-Meter Run-Walk (sec.) Trial 2	232.73	24.89	200.00-299
12-Minute Run-Walk (meters) Trial 1	1,957.67	160.47	1,588.00-2,218
12-Minute Run-Walk (meters) Trial 2	2,039.49	187.96	1,411.00-2,357
Velocity of 12-Minute Run-Walk (m/min) Trial 1	163.14	13.38	117.60-184.8

Table IV

MAXIMAL OXYGEN UPTAKE IN WOMEN

Study	N	Sample	Age	Weight	MVO$_2$ L/min	MVO$_2$ ml/Kg/min
Hermansen and Andersen	5	Norwegian	21-24	61.10	3.30	55.00
Astrand, P.O.	44	Stockholm P.E. Students	20-30	60.30	2.90	48.40
Metheny	17	P.E. Grads.	20-27			40.90
Taylor, P.S.	24	Canadian P.E. Students	17-20	59.20	2.33	39.06
Astrand, I.	32	Stockholm Housewives	20-25	59.70	2.88	48.40
Hermansen and Andersen	12	Norwegian non-athletes	21-24	61.10	2.30	38.00
Darwick	28	U.S.A. College Women	18-22		2.19	
Michael and Horvath	30	U.S.A. College Women	17-22	57.90	1.78	29.80
This Study	33	Canadian College Women	18-35	58.20	1.68	28.80

Table V

CORRELATION COEFFICIENTS

	1	2	3	4	5	6	7	8
1. MVO_2L/min	--	.82	-.44	-.31	.35	.32	.35	.32
2. MVO_2ml/Kg/min		--	-.40	-.31	.45	.41	.44	.41
3. 800-Meters (sec)T_1			--	.88	-.69	-.63	-.69	-.63
4. 800-Meters (sec)T_2				--	-.74	-.63	-.74	-.63
5. 12-Minute (m)T_1					--	.78	1.00	.78
6. 12-Minute (m)T_2						--	.78	1.00
7. 12-Minute (m/min)T_1							--	.78
8. 12-Minute (m/min)T_2								--

Table VI

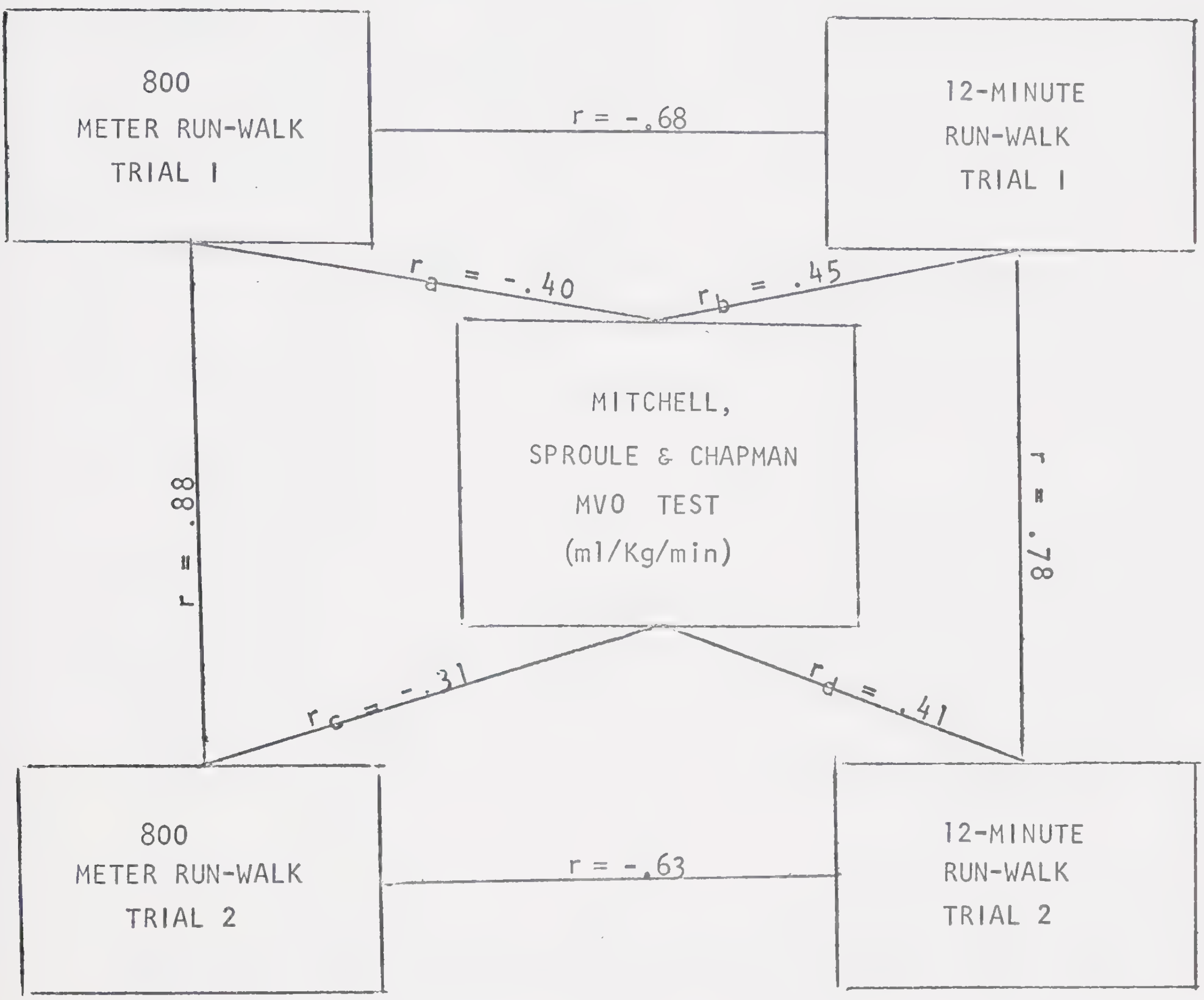
CORRELATION COEFFICIENTS FOR
MVO_2 AND BODY WEIGHT (KG.)

Body Weight	r
MVO_2 L/min	.602
MVO_2 ml/Kg/min	.049

The correlation and reliability coefficients that were found to exist between the tests are illustrated in Figure I.

Figure I

THE CORRELATION COEFFICIENTS BETWEEN THE TESTS



NOTE: For purposes of comparison, the signs of the correlation coefficients can be ignored.

To test the null hypothesis that $r_a = r_b$ and $r_c = r_d$, a t-test described by Dixon and Massey (17) was used. When the correlation coefficients were tested, no significant differences were found to exist at the .05 level of confidence.

CHAPTER V

SUMMARY AND CONCLUSIONS

Summary

The main objective of this study was to compare the 800-meter run-walk and the 12-minute run-walk tests as predictors of cardiorespiratory fitness in women, using a modified Mitchell, Sproule and Chapman Maximal Oxygen Intake Test as the criterion measure.

Thirty-three female volunteer subjects were enrolled as students at the University of Alberta and participated in the required physical education service program.

The 12-minute run-walk and the 800-meter run-walk tests were administered alternately to each subject, two times in the twenty-day testing period. The sample was randomly divided into two groups so that on a particular test-day, group one would perform one of the practical tests after which group two would perform the other field test.

In the two weeks following the practical testing, each subject performed a modified Mitchell, Sproule and Chapman test in the laboratory.

A computer zero-order correlation matrix was used to determine the correlation coefficients of the tests. The reliability coefficients of the 12-minute run-walk and the 800-meter run-walk tests were calculated, as were the correlation coefficients, by use of the Pearson product-moment method. A t-test for correlated samples was

employed to determine if there were significant differences between the correlation coefficients of the tests.

Conclusions

1. The 12-minute run-walk and the 800-meter run-walk tests yielded reasonable reliability coefficients of .78 and .88 respectively.

2. There was no significant difference at the .05 level between the correlation coefficients obtained by correlating the Mitchell, Sproule and Chapman test with the 12-minute run-walk and the 800-meter run-walk.

3. Neither the 12-minute run-walk nor the 800-meter run-walk appear to be good predictors of cardio-respiratory fitness for young college women.

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APPENDICES

APPENDIX A

RAW SCORES

Subject Number	Age	(Kg)	(in.)	MVO_2 L/min	MVO_2 ml/kg	800 m T_1 (sec)	800 m T_2 (sec)	12 min Run T_1 (meters)	12 min Run T_2 (meters)	1 M/min	2 M/min
1	19	62.73	65.5	2.28	36.35	233	229	2016.46	2078.97	168.0	173.3
2	19	69.09	65.0	1.97	28.51	204	204	2149.55	2129.38	179.1	177.5
3	18	60.46	63.0	2.08	34.40	230	234	2010.41	2206.01	167.5	183.8
4	20	43.18	66.0	1.30	30.11	233	220	1891.44	1909.59	157.6	159.1
5	18	46.82	65.0	1.05	22.43	230	229	1921.69	1966.05	160.1	163.8
6	18	70.91	66.0	1.91	26.94	262	261	1613.17	1941.85	134.4	161.8
7	20	47.73	64.0	1.16	24.30	220	223	2093.08	2218.11	174.4	184.8
8	19	48.18	66.0	.98	20.42	263	254	1909.59	1865.23	159.1	155.4
9	18	48.64	64.0	2.11	43.38	267	252	2167.69	2143.50	180.6	178.6
10	18	52.27	68.5	1.59	30.42	220	213	2117.28	2218.11	176.4	184.8
11	19	56.82	61.3	1.82	32.03	225	216	2105.18	2268.52	175.4	189.0
12	21	62.27	65.0	2.55	40.95	201	209	2218.11	2357.24	184.8	196.4
13	18	60.46	62.3	2.14	35.40	225	216	2016.46	2042.67	168.0	170.2
14	20	54.55	61.0	1.34	24.57	277	234	1945.88	1998.31	162.2	166.5
15	20	47.73	65.5	1.70	35.62	257	265	1794.65	2066.87	149.5	172.2
16	18	50.46	68.5	1.38	27.34	231	218	1853.13	2206.01	154.4	183.8
17	19	60.46	61.0	1.56	25.80	280	269	1588.97	1411.52	132.4	117.6
18	20	62.73	60.05	1.30	20.72	222	210	1891.44	2143.50	157.6	178.6
19	20	45.46	62.8	1.37	30.14	240	220	1992.26	2078.97	166.0	173.3
20	19	55.46	64.0	1.35	24.34	272	276	1853.13	1877.32	154.4	156.4
21	19	51.36	67.5	1.70	32.91	236	222	1992.26	2028.56	166.0	169.1

continued

Subject Number	Age	(Kg)	(in.)	MVO_2 L/min	MVO_2 ml/kg	800 m T_1 (sec)	800 m T_2 (sec)	12 min Run T_1 (meters)	12 min Run T_2 (meters)	1 M/min	2 M/min
22	18	76.82	63.5	2.01	26.17	234	227	2042.67	2054.77	170.2	171.2
23	19	67.27	64.5	2.30	34.19	237	214	1992.26	1927.74	166.0	160.7
24	20	53.18	65.5	1.27	23.88	247	255	1865.23	1841.03	155.4	153.4
25	19	58.64	62.0	2.09	35.64	209	208	2143.50	2306.83	178.6	192.2
26	19	74.55	60.0	2.38	31.93	207	208	2093.08	2268.52	174.4	189.0
27	20	60.00	67.0	.99	16.53	256	242	2042.67	2078.97	170.2	173.3
28	19	59.55	61.5	1.02	17.13	308	299	1613.17	1752.30	134.4	146.0
29	32	51.82	70.0	1.15	22.19	276	230	2016.46	2179.79	168.0	181.7
30	19	70.00	66.3	2.00	28.60	264	267	1695.84	1826.91	141.3	152.2
31	35	65.91	63.0	2.06	31.26	263	255	1897.49	1978.15	158.1	164.9
32	18	62.73	66.5	1.66	26.46	213	201	2042.67	1966.05	170.2	163.8
33	18	62.73	69.0	1.85	29.49	215	200	2016.46	1966.05	168.0	163.8

APPENDIX B

STATISTICAL PROCEDURES AND

SAMPLE CALCULATION SHEET

TESTS OF SIGNIFICANCE

H_o: $r_{35} = r_{37}$ H_1: $r_{35} \neq r_{37}$

Where 3 represents MVO_2 L/min

5 represents 800-meter run-walk T_1

7 represents 12-minute run-walk T_1

alpha level = .05

d.f. = N - 3 = 30

Computation: $r_{35} = .44$ $r_{37} = .35$ $r_{57} = .69$

$$t = \frac{(r_{12} - r_{13}) \quad (N - 3 \quad (1 + r_{23})}{\sqrt{2(1 - r_{12}^2 - r_{13}^2 - r_{23}^2 + 2\, r_{12}r_{13}r_{23})}}$$

$$= \frac{(.44 - .35)\ (7.12)}{.9169}$$

$$= .6989$$

Theoretical t score at alpha level of .05 with 30 d.f. is equal to or greater than $\pm$ 2.042

Calculated t score is .6989

Conclusion: Accept H_o. There is no significant difference between the correlation coefficients calculated for MVO_2 L/min and the 800-meter run-walk T_1, and MVO_2 L/min and the 12-minute run-walk T_1.

H_o: $r_{45} = r_{47}$ H_1: $r_{45} \neq r_{47}$

Where 4 represents MVO_2 in ml/(Kg)/min

5 represents 800-meter run-walk T_1

7 represents 12-minute run-walk T_1

Alpha level = .05

d.f. = N- 3 = 30

Computation: $r_{45} = .40$ $r_{47} = .45$ $r_{57} = .69$

$$t = \frac{(.40 - .45)(7.12)}{.9053}$$

$$= -.3932$$

Theoretical t score is equal to or greater than $\pm$ 2.042

Calculated t score is -.3932

Conclusion: Accept H_o. There is no significant difference between the correlation coefficients calculated for MVO_2ml/kg/min and the 800-meter run-walk T_1, and MVO_2ml/Kg/min and the 12-minute run-walk T_1.

H_o: $r_{46} = r_{48}$ H_1: $r_{46} \neq r_{48}$

Where 4 represents MVO_2 in ml/kg/min

6 represents 800-meter run-walk T_2

8 represents 12-minute run-walk T_2

Alpha level = .05

d.f. = N-3 = 30

Computation: $r_{46} = .31$ $r_{48} = .41$ $r_{68} = .63$

$$t = \frac{(.31 - .41)(6.993)}{.9989}$$

$$= -.7001$$

Theoretical t score is equal to or greater than $\pm$ 2.042.

Calculated t score is -.7001

Conclusion: Accept H_o. There is no significant difference between the correlation coefficients calculated for MVO_2ml/Kg/min and the 800-meter run-walk T_2, and MVO_2ml/kg/min and the 12-minute run-walk T_2.

H_o: $r_{25} = r_{27}$ $\qquad$ H_1: $r_{25} \neq r_{27}$

Where $\quad$ 2 represents body weight in Kg.

5 represents 800-meter run-walk T_1

7 represents 12-minute run-walk T_1

alpha level = .05

d.f. = N - 3 = 30

Computation: $r_{25} = .16 \qquad r_{27} = .03 \qquad r_{57} = .69$

$$t = \frac{(.16 - .03)(7.12)}{1.004}$$

$$= .9219$$

Theoretical t score is equal to or greater than $\pm$ 2.042

Calculated t score is .9219

Conclusion: Accept H_o. There is no significant difference between the correlation coefficients calculated for body weight in Kg. and the 800-meter run-walk T_1, and body weight in Kg. and the 12-minute run-walk T_1.

APPENDIX C

CORRELATION MATRIX

CORRELATION MATRIX

	1	2	3	4	5	6	7	8	9	10
1	1.000	-0.013	-0.058	-0.084	0.276	0.124	-0.003	0.054	-0.003	0.054
2	-0.013	1.000	0.602	0.049	-0.163	-0.079	-0.029	-0.023	-0.029	-0.023
3	-0.058	0.602	1.000	0.822	-0.435	-0.314	0.353	0.322	0.353	0.322
4	-0.084	0.049	0.822	1.000	-0.398	-0.308	0.445	0.407	0.444	0.407
5	0.276	-0.163	-0.435	-0.398	1.000	0.882	-0.686	-0.629	-0.685	-0.629
6	0.124	-0.079	-0.314	-0.308	0.882	1.000	-0.741	-0.625	-0.741	-0.625
7	-0.003	-0.029	0.353	0.445	-0.686	-0.741	1.000	0.777	1.000	0.777
8	0.054	-0.023	0.322	0.407	-0.629	-0.625	0.777	1.000	0.777	1.000
9	-0.003	-0.029	0.353	0.444	-0.685	-0.741	1.000	0.777	1.000	0.777
10	0.054	-0.023	0.322	0.407	-0.629	-0.625	0.777	1.000	0.777	1.000

Where
1. Age
2. Weight (Kg)
3. MVO_2 L/min
4. MVO_2 ml/Kg/min
5. 800-meter run-walk T_1
6. 800-meter run-walk T_1
7. 12-minute run-walk T_1
8. 12-minute run-walk T_1
9. Velocity of 12-minute run-walk m/min T_1
10. Velocity of 12-minute run-walk m/min T_1

ZERO ORDER CORRELATION MATRIX-PE557205

Correlation matrices of up to 56 variables can be computed at any one time. The output consists of the means and standard deviations of the variables, followed immediately by the inter-correlation matrix. The only restriction is that there must be an equal number of observations for all pairs of variables entering into the correlation coefficients.

INPUT

Steps

(1) CARD I - (Col. 1-2), number of matrices to be computed (12).

(2) CARD II - (Col. 1-4), number of observations (14).
(Col. 5-8), number of variables (14).

(3) CARD III - (Col. 7-72), the format of the variables as they appear on the data cards. This format must be enclosed in parentheses with the left parenthesis appearing in Col. 7. All input must be in F format.

(4) DATA CARDS - according to the format specifications required by CARD III.

When the number of matrices to be computed exceeds one,
--repeat steps 2, 3, and 4, for each matrix.

O/S REQUIREMENTS

```
     Col. 1
     ↓
1.   //PE557205_JOB_(705024,1,1), 'CORR_',MSGLEVEL=1

2.   //MATCORR_EXEC_FORTHCLG

3.   //FORT.SYSIN_DD_*

4.   Mainline program.

5.   /*

6.  //GO.SYSIN_DD_*

7.  INPUT AS DESCRIBED ABOVE

8.   /*
```

GAS ANALYSIS COMPUTATION

NAME:

AGE:

WEIGHT:

DATE:

TEMPERATURE:

BAROMETRIC PRESSURE:

FACTOR:

TREADMILL INCLINATION:

% O_{2E} = .________ × 2.5 = ________%

% CO_{2E} = ________%

% N_{2E} = 100 - ________% O_{2E} - ________% CO_{2E} = ________%

V_ESTPD = ____ (factor) × ____ L/Min. = ________L/Min.

V_ISTPD = ________V_ESTPD × $\dfrac{\text{\_\_\_\_\_\_\% } N_{2E}}{79.04}$ = __________L/Min.

IVO_2 = (_____V_ISTPD × .2093) - (_____V_ESTPD × ._______O_{2E})

= ________L/Min. Oxygen Uptake.